ON THE CINNAMOMUMS OF NEW SOUTH WALES: WITH A SPECIAL RESEARCH ON THE OIL OF *C. OLIVERI*, BAIL.

(Plate XII.-XIII.)

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Prior to this paper I can find no record of the occurrence in this colony of any indigenous representative of the Genus *Cinnamomum;* but now, after the most critical examination of the material that has come to hand, I am glad to announce that there are at least two species occurring in New South Wales, viz., *C. Oliveri*, Bail., and *C. virens*, sp.nov.

C. Oliveri, Bail.

* "Black," "Brown," or "White Sassafras."

Systematic Notes.—This species was first described by F. M. Bailey, F.L.S., of Queensland, in his Bot. Bull. v. p. 24, thus:—

"C. Oliveri, *n.sp.* (after Professor Daniel Oliver, F.R.S.) A tall tree, glabrous, except the inflorescence, trunk erect, bark smoothish, rather thin and fragrant. Leaves opposite or nearly so, lanceolate, attaining about 8 inches in length, and then scarcely over $1\frac{1}{2}$ inches broad in the widest part, colour pale, the apex blunt or minutely emarginate, on petioles of about $\frac{1}{2}$ inch, which are flattened, the upper surface glossy, the under surface of lighter colour, midrib flattish, the primary lateral nerves very oblique, few, the basal pair faint, and very near the margin until lost in the reticulation about half way up the leaf. Panicles

* To distinguish it from *Doryphora sassafras*.

slender, terminal, and in the upper axils, 2 or 3 inches long, of few branches, hoary or velvety hairy, branches few, with usually 2, 3, or 4 pedicellate flowers at the end of each branchlet. Perianth hairy on both sides, as are also the broad filaments of the stamens. Stamens all shorter than the perianth. Ovary and style glabrous; stigma peltate. The only fruit seen was much deformed by gall insect and fungus."

My material being complete I am enabled to add the following description of the fruit:—Oval in shape, measuring about $\frac{1}{2}$ inch long and under $\frac{1}{4}$ inch broad, resting in the enlarged perianth tube, the segments deciduous. They are, however, very often deformed by gall insects or fungus. Some of the "galls" measure as much as 2 inches in diameter, and are coated for $\frac{1}{8}$ inch or more with a micro-fungus *Melampsora nesodaphnes*, B. & Br., which is highly fragrant and has the appearance of a mealy powder of a canary-yellow colour. Under a one-eighth or one-tenth objective the hyphæ and spores are well brought out, the latter being oval or oblong in shape with a thick cell wall and "delicately granulated." After a time the substance of the "gall" becomes quite woody, and when the fungus is removed the surface is shown to be very irregular. An error has evidently been made in Cooke's "Australian Fungi," p. 333, under *Melampsora nesodaphnes*, B. & Br., and in all probability *Nesodaphne obtusifolia*, Benth., should read *C. Oliveri*.

The "galls" are very characteristic of the tree, and were known to me some years before I had sufficient evidence to identify the host. They occur on the trees both at Port Macquarie and Richmond River. The primary cause of this deformation of the fruits is not quite clear, as it may be due to either an insect or a fungus. It is still under investigation.

Bailey adds the following note to his description of the species: "From imperfect specimens I thought this tree only a form of Bentham's *Beilschmiedia obtusifolia*, and under which name its wood and bark have been noticed in my Catalogue of Queensland Woods, No. 315. Professor D. Oliver, of the Kew Herbarium, to whom I sent specimens of the bark for the museum, and also

herbarium specimens, pointed out to me my mistake, and hinted at the probability of its being a *Cinnamomum*, which, from the examination of somewhat better specimens, I think is the case and record it as above, although even now the material is but inperfect. So far as at present known the tree is only met with in the scrubs of the Maroochie River. Of the bark, the late K. T. Staiger said it contained a tannin similar or identical with cinchona tannin; the amount, 7½ per cent. One ton of the dry bark yields 770 oz. of oil."

Perhaps the above explanation in regard to the confusion of genera also holds good for this colony, for it certainly seems remarkable that this species in particular should have such an extensive range and yet should not have been previously recorded. I think it can only be accounted for as above stated, viz., that it has been mistaken for *Beilschmiedia (Nesodaphne) obtusifolia*, Benth., although it is hard to understand why this confusion has arisen, as the characteristics of the two genera are so very marked, and are so well defined in B. Fl. v. p. 294, that it is unnecessary to amplify them in this paper.

Complete material of both can be seen at any time in the Technological Museum.

The height of some of the trees at Mullumbimby is stated by W. Bäuerlen to be 120 feet, with a girth of 2½ feet.

Timber.—The timber when freshly cut and dressed very much resembles that of "She Beech" or "Bolly Gum" *(Tetranthera reticulata)*, or "Sycamore" *(Panax elegans)*; and I do not doubt but that much of the timber passing under these names is really obtained from *Cinnamomum*. It is greyish in colour, with frequently a black stain running through it as though decaying. It has a straight grain, is light in weight, soft and easy working. It is very susceptible to the attacks of borers even to the very heart, and is therefore of no economic value.

Oil.—As soon as I diagnosed my specimens as a *Cinnamomum* I at once procured a quantity of the bark in order to ascertain its oil-yielding qualities. It is dark red in colour, brittle, about

½ inch thick, and aromatic,—particularly so when fractured. It was ground in a bark mill, and without any salt water maceration, placed in trays that permitted a free play of steam both above and below: the layer of bark was about 2 inches, a deeper layer not being so satisfactory in its yield of oil. It was then placed in the still and subjected to a steam distillation of 30 lbs. pressure in the boiler and 5 lbs. in the still. The distilled water was white and milky in appearance, the oil not separating freely, its specific gravity of course accounting for this. The first portion of the oil that came over floated on the top of the water, the second sinking to the bottom; the whole of the water being permeated with suspended globules of oil. Our receivers were much too shallow for this specific purpose, but if a deep receiver were used and fitted with a proper arrangement of taps, a return of over 1 per cent. could be easily obtained.

The first distillation (7th and 8th July, 1897) was made on 84 lbs. of ground bark, yielding 11½ ozs. of oil or ·85 per cent.

Second distillation (13th July, 1897), weight of bark 84 lbs., yielding 13½ ozs. of oil, or 1·005 per cent.

Third distillation (15th July, 1897), weight of bark 120 lbs., yielding 14½ ozs. of oil, or ·75 per cent.

Total quantity of bark 288 lbs., giving a yield of 39½ ozs. of oil, or ·86 per cent.

As the oil contained impurities such as dirt and particles of bark, &c., it was strained first through a piece of calico and then through a filter paper, by which means I obtained a clear light golden-coloured oil with a tinge of green, and possessing a delicious odour.

The following chemical research on this oil was next undertaken by Mr. Henry G. Smith, F.C.S., Chemist of this Museum:—

The oil obtained in the three distillations gave the following results, severally and when mixed together:—

Specific gravity.—The oil of the first distillation = 1·0011 @ 16° C
,, ,, second ,, = 1·0012 @ ,,
,, ,, third ,, = 1·0010 @ ,,

The whole oil obtained when mixed together had a specific gravity of 1·00105 @ 16° C.

These determinations were made with a delicate pyknometer, holding about 12 grams.

Specific rotation.—This was taken in a tube 200 mm. long; using the sodium flame, the oils were found to be dextro-rotatory as follows:—

First oil—angle observed	+ 22·3	therefore	$[\alpha]$ D + 11·137.
Second oil ,,	+ 22·2	,,	$[\alpha]$ D + 11·080.
Third oil ,,	+ 22·0	,,	$[\alpha]$ D + 11·000.

These were then mixed, when the rotation was + 22·1, or a specific rotation $[\alpha]$ D + 11·038. All taken at 16° C.

Redistillation.—100 c.c. of the oil were distilled at the ordinary atmospheric pressure with the following results:—Only a few drops had been obtained at 185° C, the mercury then rapidly rose to 204° C, between this and 213° C, 5 per cent. had been obtained.

	Below	213° C*			5	per cent.
First fraction collected.	Between	213	and	217·2° C =	7	,,
	,,	217·2	,,	221·4° C =	8	,,
	,,	221·4	,,	224·6° C =	7	,,
	,,	224·6	,,	226·7° C =	7	,,
	,,	226·7	,,	229·8° C =	7	,,
	,,	229·8	,,	235 ° C =	16	,,
Second fraction.	,,	235	,,	240·3° C =	17	,,
	,,	240·3	,,	245·6° C =	11	,,
Third fraction.	,,	245·6	,,	253 ° C =	10	,,
	Residue boiling above			253 ° C =	5	,,

Evidently better fractions could be obtained by changing at 230° C as 54 per cent. distils between that temperature and 253° C.

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* These temperatures have been corrected to the nearest decimal.

The fractions obtained as above gave the following results :— First fraction, between 213° C and 235° C, had a specific gravity of ·995 @ 16° C, being thus lighter than water. It had a specific rotation of [α] D + 15·86, or half as much again as that obtained for the whole oil.

Second fraction, between 235 and 245·6° C, had a specific gravity of 1·0166 @ 16° C, and the specific rotation was [α] D + 5·066, or less than half that obtained for the whole oil. It is perhaps remarkable that the fractions should have been thus separated, as the mean of the two rotations of these fractions is nearly that of the whole oil.

Third fraction, between 245·6 and 253° C, had a specific gravity of 1·004 @ 17° C. The material was not sufficient to enable the rotation to be taken.

The original oil is yellowish, inclining to brownish, with a tinge of green. The first two fractions are yellowish to brownish, while the third fraction is distinctly green.

When the original oil was subjected to the action of cold, a stearoptene crystallised out in small quantity, the temperature being 12 degrees below zero. It was not possible to separate it as it disappeared very quickly on removing from the freezing mixture, evidently melting below zero.

A portion of the oil was agitated with a solution of potash, the aqueous solution separated, and acidified with dilute sulphuric acid ; no oil separated, but the solution was turbid ; this was agitated with ether, the ether separated and evaporated, when a minute quantity of an oil was obtained, which became quickly brown, and which had a very strong odour of cloves. When dissolved in alcohol, ferric chloride gave the blue reaction. It is to be supposed, therefore, that the phenol is *Eugenol*, and that it is only present in traces.

A portion of the oil was mixed with a concentrated solution of acid sulphite of soda, and well agitated. A small quantity of a crystalline compound was obtained ; this was separated entirely from adhering oil and acidified with dilute sulphuric acid in a graduated tube. The separated oil when measured equalled $1\frac{1}{2}$

per cent. of the original oil. It was of a dark brown colour and had the odour of cinnamon most markedly. It constitutes the material that gives the slight brownish tinge to the original oil, because when it was removed the oil was yellowish to greenish. The oil contains therefore less than 2 per cent. of *cinnamic aldehyde*.

None of the terpenes of low boiling point are present, nor could phellandrene be detected. A distinct reaction for cineol was obtained with iodol.

This oil, therefore, cannot be classed with the cinnamon oil of commerce, nor with cassia oil, as it is deficient in cinnamic aldehyde, although the principal constituents of those oils (cinnamic aldehyde and eugenol) were present.

Further researches are in progress to locate the principal constituent of this oil.

Mr. K. T. Staiger, in the Colonial and Indian Exhibition Report (1886, p. 11), gives the yield of oil of *C. Oliveri*, Bail. (under *Nesodaphne obtusifolia*, Benth.), as 2 per cent., obtained by a laboratory experiment, but which therefore can hardly be taken into account from a commercial point of view. As regards Dr. Lauterer's figures* (about ·1 per cent.), these were also obtained in the laboratory from 10 lbs. of bark, and therefore are insufficient to determine definitely the commercial possibilities of distilling this oil. The results obtained at the Museum by us gave the actual yield obtainable on a commercial scale, and from them I am unable to endorse Dr. Lauterer's statement "that it never will pay even the expense to distil the essential oil out of the bark for commercial purposes."

I am of opinion that my own experiments point out that a profitable distillation of this oil is practicable, as there is only a little more difficulty in obtaining it than there is in extracting the oil from the leaves of the Eucalypts; a little extra patience only being required in separating the oil from the water of dis-

* Proc. Roy. Soc. Queensland. Vol. xi. p. 20.

tillation. Only bark from the stem was treated, but if the whole bark of a tree were distilled, and also the leaves and roots,—for each of these gives a distinctive oil,—then the total quantity of oil to be obtained from a tree of 70 or 100 feet (average height) would be considerable, and should prove a remunerative industry.

Efforts will now be made to obtain the exact value and commercial possibilities of this oil,—which we propose shall be known in future as Oliverian oil.

Dr. Lauterer states* that this bark is frequently used by bushmen to improve the flavour of their tea, a little bit of bark being infused therewith. This bark has been used by many medical men as a convenient aromatic astringent in diarrhœa, and has been recommended by the Medical Society of Queensland for insertion in the B.P.

Hab.—Mullumbimby, Tweed River (W. Bäuerlen); Port Macquarie (Forester Brown); and probably extends along the whole coast district to the Illawarra (C. Hedley).

Cinnamomum virens, sp.nov.

"Wild Camphor Laurel." "Copal Tree."†

A tree about 90 feet high and up to 2 feet in diameter. Leaves opposite or occasionally alternate, rigid, coriaceous, shining above, green and glabrous on both sides, the reticulations prominent on the underside, lanceolate-acuminate, either cuneate or rounded at the base, margins nerve-like, 4 to 6 inches long, triplinerved but not prominently so, petiole rarely exceeding $\frac{1}{4}$ inch. Panicles opposite in the axils of the upper leaves, bearing a few flowers in the raceme shorter than the leaves, slightly pubescent. Pedicels the length of the calyx. Perianth tube about 1 line, segments or lobes 2 lines long, constricted for about half its length so as to give it a calyx-like appearance as soon as the ovules are fertilised. Stamens shorter than the lobes. Stigma very slightly

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* *Loc. cit.* p. 24.

† On account of the high polish of the leaves and fruit.

expanded. Berry 6 lines long, 4 broad, resting on an enlarged perianth tube measuring across the top almost 5 lines, shining. Pedicels enlarged under the fruit, the whole resembling some Quercus fruits and cups such as *Q. pedunculata*, &c.

Hab. — Tintenbar, Mullumbimby, Dunoon, Gonellah (W. Bäuerlen).

This species was first collected at Lismore by W. Bäuerlen. It differs from *C. Oliveri* in its foliage, the uniform colour of the upper and lower surfaces of its leaves giving it a distinctive character from those of that species, which are dark green coloured on the the upper surface and whitish below. The neuration found in most other Cinnamomums is slightly developed in this species, although wanting in *C. Oliveri*. Some specimens preserve a light green colour, others darken a little, but the colour is always distinct from *C. Oliveri*, Bail., *C. ovalifolium*, Wight, *C. Tamala* Nees, and *C. Zeylanicum*, Nees; the leaves are also thicker, more rigid, and less fragrant than those of *C. Oliveri*.

The bark is thin, non-aromatic, and a distillation of 60 lbs. gave very little oil.

The remarks on the timber of *C. Oliveri* are also applicable to this species.

It differs from *C. Tamala*, Nees, the only Australian representative of this genus recorded in B. Fl. v. 303 (allowing for all variations), in the shape, colour, size and venation of the leaf, as well as in the characters of the stigma; from *C. ovalifolium*, Wight, in its lanceolate, unicoloured, glabrous leaves, which are also less coriaceous than those of that species.

The perianth is very much more enlarged and thickened than in *C. Oliveri*, Bail., which has an entire and thin-edged enlarged perianth tube, whilst this one appears to show rudimentary lobes. The fruits also are larger than those of *C. Oliveri*, Bail., and very shining.

F. M. Bailey (in Bot. Bull. v. p. 25) refers to a probably new species of Cinnamomum under the name of *C. propinquum*, but I do not think that my specimens can belong to that species, as the branchlets are not 4-angled, neither are the leaves ovate-lanceolate;

they are nearly all above 3 inches long, and the under surface is not whitish but green, the same as the upper surface, with the reticulations distinct.

My species has very little affinity with *C. ovalifolium*, Wight, specimens of which have been kindly sent to me for comparison by Mr. J. C. Willis, M.A., Royal Botanical Gardens, Ceylon.

I have to tender my thanks to Dr. W. Prain, of the Royal Botanic Gardens, Seebpore, Calcutta, for kindly sending me specimens of *C. Tamala*; to Mr. J. C. Willis, M.A., of the Royal Botanic Gardens, Ceylon, for specimens of *C. ovalifolium*: to Mr. F. M. Bailey, F.L.S., for specimens of the Queensland Cinnamon, *C. Tamala;* to Mr. J. H. Maiden, F.L.S., Sydney Botanic Gardens, for specimens of *C. Zeylanicum*; and also to Mr. G. Beyer, for valuable assistance in the preparation of this paper.

EXPLANATION OF PLATES.

Plate XII.

Cinnamomum Oliveri, Bail.

Fig. 1.—Terminal twig with inflorescence.
Fig. 2.—Individual flower (enlarged).
Fig. 3.—Stamen (enlarged).
Fig. 4.—Staminodia (enlarged).
Fig. 5.—Glands at base of inner perfect stamens (enlarged).
Fig. 6.—Pistil.
Fig. 7.—Cluster of fruits on enlarged perianth.
Fig. 8.—Galls, coated with fungus.
Fig. 9.—Spores and hypha of *Melampsora nesodaphnes*.

Plate XIII.

Cinnamomum virens, R.T.B.

Fig. 1.—Inflorescence.
Fig. 2.—Twig with more mature flowers than No. 1, and also early fruits.
Fig. 3.—Individual flower from No. 2 (enlarged).
Fig. 4.—Stamens, inner and outer series (enlarged).
Fig. 5.—Stamen, outer series (enlarged).
Fig 6.—Staminode (enlarged).
Fig. 7.—Pistil (enlarged).
Fig. 8.—Early fruit (enlarged).
Fig. 9.—Fruit on enlarged perianth (enlarged).